Docket No.: 1293.1215

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Sung-hee HWANG, et al.

Serial No. 10/022,826 Group Art Unit: 2615

Confirmation No.

Filed: December 20, 2001 Examiner: To be assigned

For: OPTICAL RECORDING MEDIUM, DATA RECORDING OR REPRODUCING APPARATUS, AND DATA RECORDING OR REPRODUCING METHOD USED BY THE DATA RECORDING OR REPRODUCING APPARATUS

SUBMISSION OF ENGLISH TRANSLATION OF PRIOR FOREIGN APPLICATION IN ACCORDANCE WITH 37 C.F.R. § 1.78

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

The applicants submit herewith an English translation of U.S. Provisional Application Serial No. 60/284,881 and a statement from the translator that the translation is accurate in compliance with 37 C.F.R. §1.78.

Respectfully submitted,

STAAS & HALSEY LLP

Date: 8/9/02

By: [signature]
Michael D. Stein
Registration No. 37,240

700 Eleventh Street, NW, Suite 500
Washington, D.C. 20001
(202) 434-1500

IN THE MATTER OF

U.S. Provisional Application

By Samsung Electronics Co., Ltd

I, Jung-kum Lee, an employee of Y.P.Lee & Associates of The Cheonghwa Bldg., 1571-18 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare that I am familiar with the Korean and English language and that I am the translator of U.S. Provisional Application and certify that the following is to the best of my knowledge and belief a true and correct translation.

Signed this 14th day of July 2001

Leejungkum

Jung-kum Lee

OPTICAL RECORDING MEDIUM, DATA RECORDING APPARATUS AND DATA RECORDING METHOD USED BY THE APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to error correction, and more particularly, to an optical recording medium on which data is recorded in a way which allows the medium to be used as a high definition-digital versatile disc (HD-DVD), a data recording apparatus, and a data recording method used by the apparatus.

2. Description of the Related Art

Considering that digital broadcasting following the standard of the advanced television systems committee (ATSC) started in the U.S. in November, 1998, it is likely that digital broadcasting will soon be commonly used. However, current DVDs have a capacity of 4.7-10 gigabytes, and thus a two-hour movie (about 25 gigabytes) which is received via digital broadcasting cannot be recorded in a disc. As a result, a high density recording medium for recording a digital broadcast having the size of a movie is required.

A method for reducing the size of a laser beam used in recording/reading data is a representative example of a method for increasing recording density. The smaller the radius of the laser beam the more densely an information track in which data are recorded can be formed, thereby increasing recording density. However, if only the radius of the laser beam is decreased, the quantity of light used in recording/reading data is also reduced, and the effect caused by damage or dust occurring on the surface of the disc is relatively increased. That is, an error generation rate in recording/reading data is increased.

SUMMARY OF THE INVENTION

To solve the above problem, it is a first object of the present invention to provide an optical recording medium, a data recording apparatus, and a data recording method used by the apparatus, which have higher error correction rates in recording/reading data such that the optical recording medium, data recording

apparatus, and data recording method used by the apparatus can be applied to a high density recording medium.

It is a second object of the present invention to provide an optical recording medium, a data recording apparatus, and a data recording method used by the apparatus, which are compatible with the format of a conventional digital versatile disc (DVD) and have higher error correction rates.

Accordingly, to achieve the above objects, there is provided a method for recording data on an optical disc. The method includes the steps of (a) dividing each of a plurality of error correction code (ECC) blocks into a plurality of units in the row direction and a plurality of units in the column direction to generate a plurality of partitions, (b) alternately extracting data of the partitions from each of the ECC blocks, and (c) interleaving the extracted data to generate a recording block.

It is preferable that the method further includes the steps of (d) modulating the generated recording block, and (e) recording the modulated recording block.

The step (a) includes the steps of (a11) dividing each of the ECC blocks in a column direction by a predetermined number of bytes, and (a12) dividing each of the ECC blocks in a row direction by a predetermined number of bytes to generate a plurality of partitions.

It is preferable that a predetermined number of bytes of data are extracted in the step (b), and the extracted data are sequentially interleaved to generate the recording block in the step (c).

The step (a) further includes the steps of (a21) obtaining a common divisor **d** for N1 and N2 when the size of the ECC blocks is N1xN2 bytes, (a22) dividing each of the ECC blocks into units of **d** bytes in the column direction, and (a23) dividing each of the ECC blocks into a number **d** of portions in the row direction to generate a number 2 x d x d of partitions.

Also, in order to achieve the above objects, according to another aspect of the present invention, there is provided a method for recording data on an optical disc. The method includes the steps of (a) dividing each of two ECC blocks in a row direction and a column direction to obtain a plurality of partitions, (b) alternately extracting data of the partitions from each of the ECC blocks, and (c) interleaving the extracted data to generate a recording block.

The step (a) includes the steps of (a11) dividing each of the ECC blocks in the column direction by a predetermined number of bytes, and (a12) dividing each of the ECC blocks in the row direction by a predetermined number of bytes to generate a plurality of partitions.

It is preferable that a predetermined number of bytes of data are extracted in the step (b), and the extracted data are sequentially interleaved to generate the recording block in the step (c).

Further, the step (a) includes the steps of (a21) obtaining a common divisor **d** for N1 and N2 when the size of the ECC blocks is N1xN2 bytes, (a22) dividing each of the ECC blocks into units of **d** bytes in the column direction, and (a23) dividing each of the ECC blocks into a number **d** of portions in a row direction to generate a number 2 x d x d of partitions.

In particular, in step (b), it is preferable that the data of the partitions are interleaved such that a number 2 x N2 of row-code words are included in the block obtained after interleaving the data.

In step (c), it is preferable that the ECC blocks have row-code words (N1, k1), and column-code words (N2, k2), and the block including 2 x N2 row-code words is converted to generate a recording block which is divided into a main data region of 2 x (N2-k2) bytes and an outer parity region of 2 x k2 bytes.

Meanwhile, in order to achieve the above objects, according to another aspect of the present invention there is provided an apparatus for recording data on an optical disc. The apparatus includes an error correction code (ECC) encoder for generating a plurality of error correction code (ECC) blocks in which main data are recorded, and an interleaver including a partitioning portion for dividing each of the generated ECC blocks into a plurality of units in the row direction and a plurality of units in the column direction so as to generate a plurality of partitions, a data extracting portion for alternately extracting data of the partitions from each of the ECC blocks, and a recording block generating portion for interleaving the extracted data and generating a recording block.

The apparatus further includes a modulating portion for modulating the generated recording block, and a recording portion for recording the modulated recording block.

The partitioning portion divides each of the generated ECC blocks into a plurality of units in the row direction and a plurality of units in the column direction so as to generate a plurality of partitions. In particular, the partitioning portion obtains a common divisor **d** for N1 and N2 when the size of the ECC blocks is N1xN2 bytes, and then divides each of the ECC blocks into units of **d** bytes in the column direction, and then divides each of the ECC blocks into a number **d** of portions in a row direction to generate a number 2 x d x d of partitions.

The recording block generating portion sequentially interleaves the extracted data to generate a recording block.

Also, in order to achieve the above objects, according to another aspect of the present invention, there is provided an apparatus for recording data on an optical disc. The apparatus includes an error correction code (ECC) encoder for generating two error correction code (ECC) blocks, and an interleaver for dividing each of the two generated ECC blocks into a plurality of units in the row direction and a plurality of units in the column direction so as to generate a plurality of partitions, alternately extracting data of the plurality of partitions from each of the ECC blocks, and interleaving the extracted data and generating a recording block.

The interleaver obtains a common divisor **d** for N1 and N2 when the size of the ECC blocks is N1xN2 bytes, and then divides each of the ECC blocks into units of **d** bytes in the column direction, and then divides each of the ECC blocks into a number **d** of portions in the row direction to generate a number 2 x d x d of partitions. In particular, it is preferable that the data of the partitions are interleaved such that a number 2 x N2 of row-code words are included in the block obtained after interleaving the data.

Also, it is more preferable that the ECC encoder generates error correction code (ECC) blocks having row-code words (N1, k1) and column-code words (N2, k2), and the interleaver converts a block including 2 x N2 row-code words to generate a recording block which is divided into main data region of a 2 x (N2-k2) bytes and an outer parity region of a 2 x k2 bytes.

Meanwhile, in order to achieve the above objects, according to another aspect of the present invention there is provided an optical recording medium in which data included in a plurality of recording blocks are sequentially recorded. In the optical recording medium, data which are included in partitions are interleaved in the recording block.

Here, it is effective that the data of the partitions are alternately extracted from each of the ECC blocks and interleaved.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIGS. 1A and 1B are block diagrams of a data recording apparatus according a preferred embodiment of the present invention;

FIG. 2 illustrates the format of error correction code (ECC) blocks which are interleaved according to the present invention;

FIG. 3 illustrates the format of a block generated by interleaving of FIG. 2;

FIG. 4 illustrates a recording block rearranged on the basis of the block of FIG. 3;

FIG. 5 is an example of the ECC blocks A and B of FIG. 2;

FIG. 6 illustrates the format of the block generated by interleaving of FIG. 5;

FIG. 7 illustrates a recording block rearranged on the basis of the block of FIG. 6;

FIG. 8 illustrates the largest error that can be corrected by error correction according to the present invention; and

FIGS. 9A and 9B are block diagrams of a data reproducing apparatus according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings.

FIGS. 1A and 1B are block diagrams of a data recording apparatus according a preferred embodiment of the present invention. Referring to FIG. 1A, the data recording apparatus includes an error correction code (ECC) encoding portion 1, a modulating portion 3, and a recording portion 5. The ECC encoding portion 1 includes an ECC encoder 11 and an interleaver 12. The interleaver 12 includes a partitioning portion 121, a data extracting portion 122, and a recording block generating portion 123.

The ECC encoder 11 encodes main data with error-correction-code (ECC) encoding according to a predetermined encoding method. The interleaver 12 interleaves the ECC-encoded main data according to the present invention and generates a recording block. 「Interleaving」 is done to increase error correction efficiency and is a method for physically distributing contiguous main data in ECC blocks and recording it on an optical disc. A burst error can be very effectively corrected by performing 「interleaving」. In order to perform 「interleaving」 according to the present invention, the partitioning portion 121 divides each of the generated ECC blocks in a row direction and a column direction to obtain a plurality of partitions. The data extracting portion 122 alternately extracts the data of the partitions from each of the ECC blocks. The recording block generating portion 123 interleaves the extracted data to generate a recording block. A more specific 「interleaving」 method will be described later.

The modulating portion 3 modulates the recording block generated by the ECC encoding portion 1 according to a predetermined modulating method. The modulating method used in this embodiment is eight to fourteen modulation plus EFM+), that is, a method for modulating each byte of the recording block data into a 16 bit code. The recording portion 5 records the modulated recording block on an optical disc 100. When recording the modulated recording block on the optical disc 100, a channel bit pulse stream which a modulated bit stream is converted into by non return to zero inversion (NRZI) coding according to the embodiment, is recorded. Here, various converting methods for recording the channel bit pulse stream can be used.

FIG. 2 illustrates the format of ECC blocks which are interleaved according to the present invention. Referring to FIG. 2, each of ECC blocks A and B consists of

N1 bytes of data in a row direction, and N2 bytes of data in a column direction. Row-code words consisting of main data and an inner parity are arranged in a row direction. Here, a predetermined number of row-code words constitute one sector. Alternatively, at least one sector could be arranged in a column direction, and row-code words having an identifier ID are included in each sector.

The row-code words can be obtained by Reed-Solomon Product coding. That is, each row is a RS(N1, m, p) code. Here, N1 is the total size of the code words, m is the size of the main data, and p is the number of parity bit plus one. Since Reed-Solomon Product coding is good at correcting multi-errors and is used in digital versatile discs (DVD), Reed-Solomon Product coding is selected for compatibility with DVDs. However, the coding method used can be changed when needed. Similarly, the size of the ECC blocks and the number of bytes allocated to the parity can be changed. The identifier ID and a parity for error detection, that is, for error detection (EDC), are included in each sector. The address of the main data included in the corresponding sector is recorded in the identifier ID. Thus, the main data can be searched by the identifier ID.

Interleaving for constituting a recording block according to the present invention is performed on the basis of the following.

As shown in FIG. 2, first, each of the ECC blocks A and B is divided into units of **d** rows in a column direction. Here, **d** is a common divisor for N1 and N2. Thus, the ECC blocks A and B are divided into a number d x d partitions. As a consequence, a total of 2 x d x d partitions are generated in each of the ECC Blocks A and B. These partitions are 1_1, 1_2, . . . , 1_2 x d, 2_1, 2_2, . . . , 2_2 x d, . . . , d_1, d_2, . . . , and d_2 x d.

The following data can be arranged in the partition such as 1_1, 1_2, . . . , 1_2 x d, 2_1, 2_2, . . . , 2_2 x d, . . . , d_1, d_2, . . . , and d_2 x d, which are finally obtained.

Partition 1_1: N1/d of numbers having 1 of a remainder divided by 2 x d among numbers 1_2 x N1, are sequentially arranged.

Partition 1_2: N1/d of numbers having 2 of a remainder divided by 2 x d among numbers of 1_2 x N1, are sequentially arranged.

. . .

Partition 1_2 x d: N1/d of numbers having 0 of a remainder divided by 2 x d among numbers 1_2 x N1, are sequentially arranged.

Partition 2_1: N1/d of numbers having 1 of a remainder divided by 2 x d among numbers 2 x N1+1_2 x N1+2 x N1, are sequentially arranged

Partition 2_2: N1/d of numbers having 2 of a remainder divided by 2 x d among numbers 2 x N1+1_2 x N1+2 x N1, are sequentially arranged.

. . .

Partition 2_2 x d: N1/d of numbers having 0 of a remainder divided by 2 x d among numbers 2 x N1+1_2 x N1+2 x N1, are sequentially arranged.

. . .

Partition d_1: N1/d of numbers having 1 of a remainder divided by 2 x d among numbers (d_1) x 2 x N1+1_d x 2 x N1, are sequentially arranged.

Partition d_2: N1/d of numbers having 2 of a remainder divided by 2 x d among numbers (d_1) x 2 x N1+1_d x 2 x N1, are sequentially arranged.

. . .

Partition d_2 x d: N1/d of numbers having 0 of a remainder divided by 2 x d among numbers (d_1) x 2 x N1+1_d x 2 x N1, are sequentially arranged.

This is generalized as following:

m_n: N1/d of numbers having n of a remainder divided by 2 x d among numbers of (m-1) x 2 x N1+1_m x 2 x N1 is n, are sequentially arranged.

Next, data are extracted from the partitions in numerical order. That is, first, data are extracted from the partition 1_1, second, from the partition 1_2, . . . , and (2 x d)-th, from the partition 1_2 x d. Again, (2 x d +1)-th, data are extracted from the partition 1_1, and (2 x d +2)-th, from the partition 1_2, . . . , and (2 x d +2 x d)-th, from the partition 1_2 x d. In this order, all data are extracted from the partitions 1_1, 1_2, . . . , 1_2 x d, and then, data are alternately extracted from the partitions 2_1, 2_2, . . . , 2_2 x d.

The above procedure is performed repeatedly in a unit of **d** rows. The recording block generated as a result of performing the above procedure is shown in FIG. 3.

Referring to FIG. 3, the block generated according to FIG. 2 is comprised of data of a 2 x (N2-k2) row and an outer parity of a 2 x k2 row. The generated block can be rearranged on the basis of a sector of 2KB for recording.

FIG. 4 illustrates a recording block rearranged on the basis of the block of FIG. 3. Referring to FIG. 5, a 2 x (N2-k2)/ 32 row is extracted from main data included in the block of FIG. 3, and arranged, and a 2 x k2/32 row is extracted from the outer parity and arranged, thereby forming one sector. The number of sectors generated by the above procedure is 32 in total. The reason for forming 32 sectors is that one error correction code (ECC) block in DVDs is comprised of 16 sectors. In other words, compatibility with DVDs is considered.

The range of a burst error correction which can be corrected by Reed-Solomon Product coding in conventional DVDs is 16 rows x 182 bytes + 10 bytes, that is, 2,922 bytes. Here, 16 rows are the number of sectors included in the ECC block defined in the DVD, 182 bytes are the row of the ECC block defined in the DVD, and 10 bytes are inner parity.

FIG. 5 is an example of the ECC blocks A and B of FIG. 2. Referring to FIG. 5, the ECC blocks A and B denote a case where N1=182 bytes, N2=208 bytes, and d=2. In this case, the recording block according to the present invention is generated by performing interleaving described below.

First, each of the ECC blocks A and B is divided into two partitions in a unit of 2 rows in a row direction. As a result, a total of eight partitions such as ①, ②, ③, ④, ⑤, ⑥, ⑦, and ⑧, exist in the ECC blocks A and B. Next, first data are extracted from the partition ①, second data are extracted from the partition ③, third data are extracted from the partition ⑥, and fourth data are extracted from the partition ⑧. Again, fifth data are extracted from the partition ①, sixth data are extracted from the partition ③, seventh data are extracted from the partition ⑥, and eighth data are extracted from the partition ⑧. In this way, after extracting all data from the partitions ①, ③, ⑥, and ⑧, again, data are alternately extracted from the partitions ②, ④, ⑤, and ⑦. The above procedure is performed repeatedly in a unit of 2 rows. The recording block generated as a result of performing the above procedure is shown in FIG. 6.

Referring to FIG. 6, the recording block generated according to FIG. 5 is comprised of 384 rows of data and an outer parity of 32 rows. Here, the generated recording block can be rearranged on a sector basis for recording.

FIG. 7 illustrates a recording block rearranged on the basis of the block of FIG. 6. Referring to FIG. 7, 12 rows are extracted from main data included in the block of FIG. 6 and arranged, and 1 row is extracted from the outer parity and arranged, thereby forming one sector. The number of sectors generated by the above procedure is 32 in total. Since one error correction code (ECC) block in the DVD is comprised of 16 sectors, compatibility with DVDs is considered.

FIG. 8 illustrates the largest error that can be corrected by error correction according to the present invention. For example, the largest error that can be corrected by error correction used in RS(182, 172, 11) x RS(208, 192, 17) is decided as below.

Referring to FIG. 8, first, in a case where errors occur in 31 consecutive rows, and errors of each 20 bytes, in total, errors of 40 bytes, consecutively occur at the beginning and end of 31 rows, an outer parity of 3 rows is an error of 2 rows in the recording block obtained by interleaving according to the present invention, and main data of 28 rows are an error of 14 rows in the recording block obtained by interleaving according to the present invention, and thus, in total, a code of 16 rows can be corrected by the outer parity. Also, since an error of 20 bytes occurring at the beginning of 31 rows results in an error of 2 rows respectively consisting of one 5 bytes from one ECC block and the other 5 bytes from the other ECC block in the recording block, the error of 20 bytes can be corrected by the inner parity. Also, an error of 20 bytes occurring at the end of 31 rows results in an error of 2 rows respectively consisting of one 5 bytes from one ECC block and the other 5 bytes from the other ECC block in the recording block, and thus can be corrected by the inner parity.

Thus, in total, 182 bytes x 31 + 40 bytes = 5, 682 bytes are corrected.

In this way, according to the present invention, interleaving between blocks is performed by using two conventional ECC blocks, and interleaving between code words in each block is performed to generate the recording block. As a result, the

burst error is distributed into two regions, and the improvement of the correction ability of the inner parity by interleaving between code words is doubled.

Meanwhile, in the above-mentioned embodiment, a method for interleaving two ECC blocks was already described, but it is also possible to apply interleaving to more than two ECC blocks. That is, a common divisor between more than two ECC blocks can be obtained, and then, each ECC block can be divided into a plurality of partitions on the basis of the row of the obtained common divisor. Next, at least part of data, which are included in the divided plurality of partitions, are extracted from the partitions, thereby interleaving the data. The extraction of the data is performed so that each ECC block is alternately selected. The recording block obtained by interleaving can be consecutively recorded or can be rearranged on a sector basis.

FIGS. 9A and 9B are block diagrams of a data reproducing apparatus according to the present invention. Referring to FIG. 9A, the data reproducing apparatus includes a reading portion 13, a demodulating portion 12, and an ECC decoding portion 11. The reading portion 13 reads data from an optical disc 900 on which data are recorded according to the present invention. The demodulating portion 12 demodulates the read data. The demodulating method used depends on the modulating method.

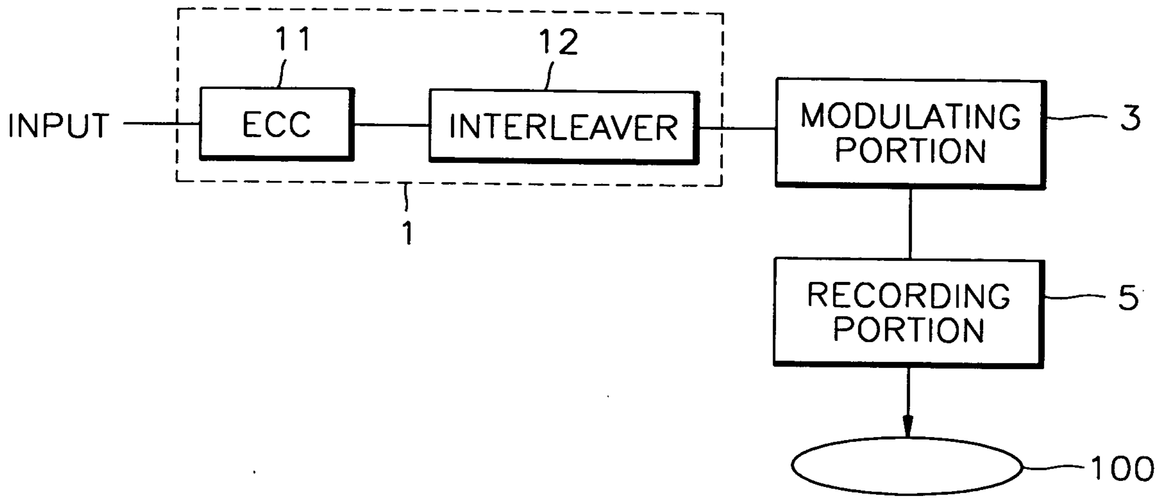
The ECC decoding portion 11 ECC-decodes the demodulated data, that is, a recording block. More specifically, referring to FIG. 10B, the ECC decoding portion 11 includes a deinterleaver 111 and an ECC decoder 112. The deinterleaver 111 deinterleaves the recording block in the order reverse to the interleaver 12 of FIG. 1B to generate a plurality of error correction code (ECC) blocks. The ECC decoder 112 decodes the demodulated data into main data with codes, which are used in the generated ECC block, and outputs the main data.

As described above, according to the present invention, the optical recording medium, the data recording apparatus, and the data recording method used by the apparatus, which are compatible with the format of a conventional digital versatile disc (DVD) and have higher error correction rates, are provided.

Abstract of the Disclosure

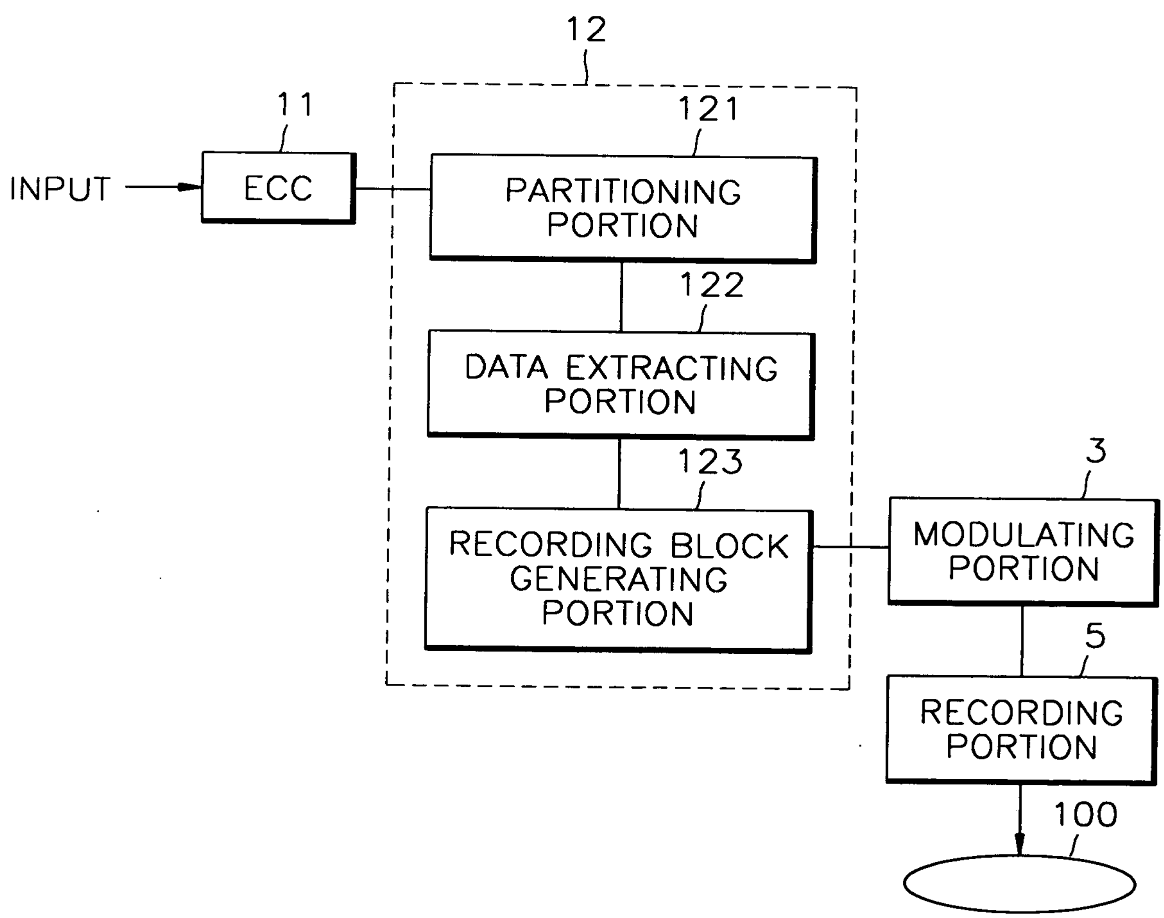
An optical recording medium, a data recording apparatus, and a data recording method used by the apparatus are provided. The method includes the steps of (a) dividing each of a plurality of error correction code (ECC) blocks into a plurality of units in the row direction and a plurality of units in the column direction to generate a plurality of partitions, (b) alternately extracting data of the partitions from each of the ECC blocks, and (c) interleaving the extracted data to generate a recording block. The generated recording block is modulated and recorded on an optical disc. As a result, the optical recording medium, the data recording apparatus, and the data recording method used by the apparatus, which are compatible with the format of the conventional digital versatile disc (DVD) and have higher error correction rates, are provided.

FIG. 1A



11
12
INPUT
ECC
INTERLEAVER
MODULATING PORTION
3
1
RECORDING PORTION
5
100

FIG. 1B



12
11
121
INPUT
ECC
PARTITIONING PORTION
122
DATA EXTRACTING PORTION
123
3
RECORDING BLOCK GENERATING PORTION
MODULATING PORTION
5
RECORDING PORTION
100

FIG. 2

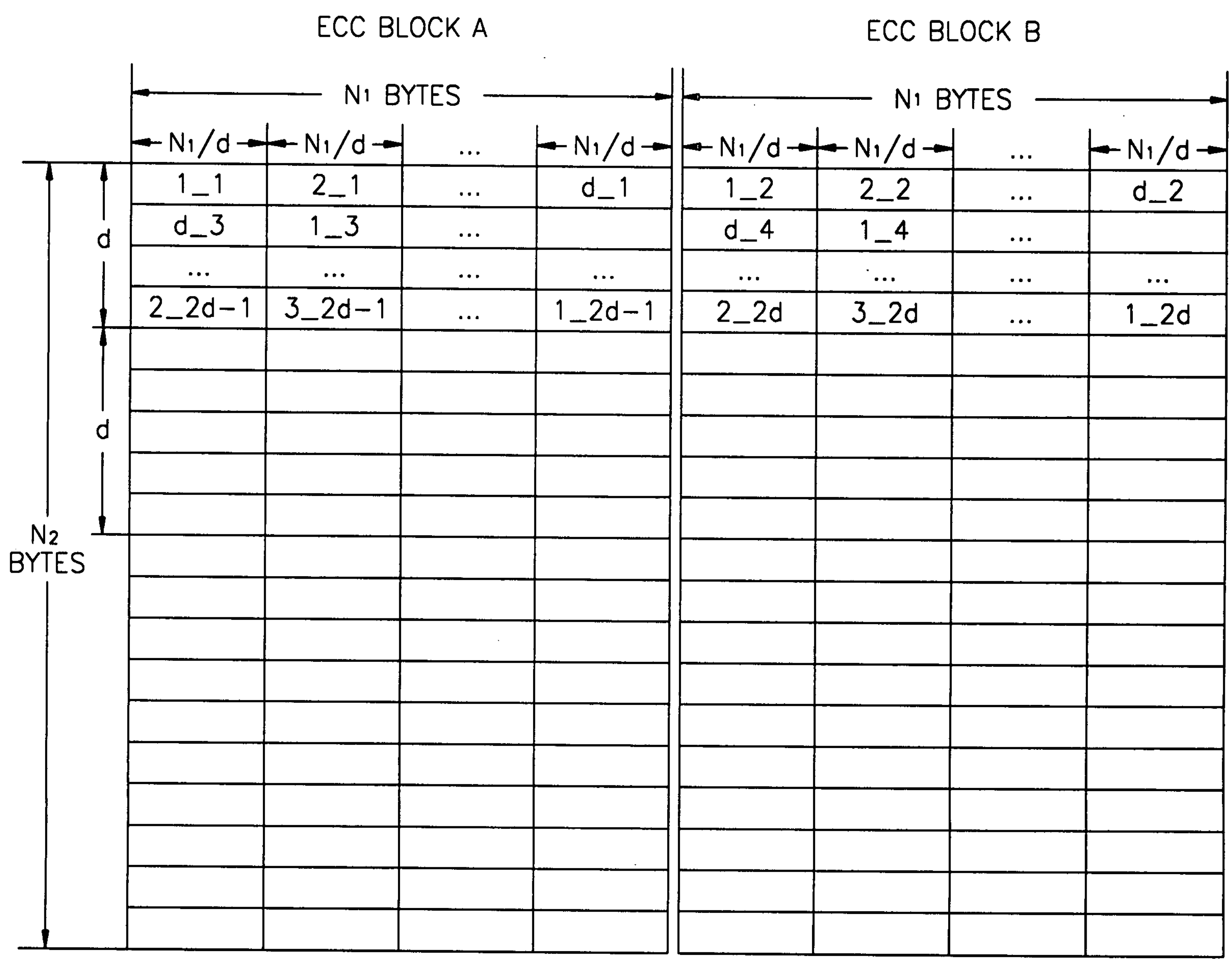

ECC BLOCK A
ECC BLOCK B
N1 BYTES
N1 BYTES
N1/d
...
1_1
2_1
d_1
d_3
1_3
2_2d-1
3_2d-1
1_2d-1
1_2
2_2
d_2
d_4
1_4
2_2d
3_2d
1_2d
d
d
N2 BYTES

FIG. 3

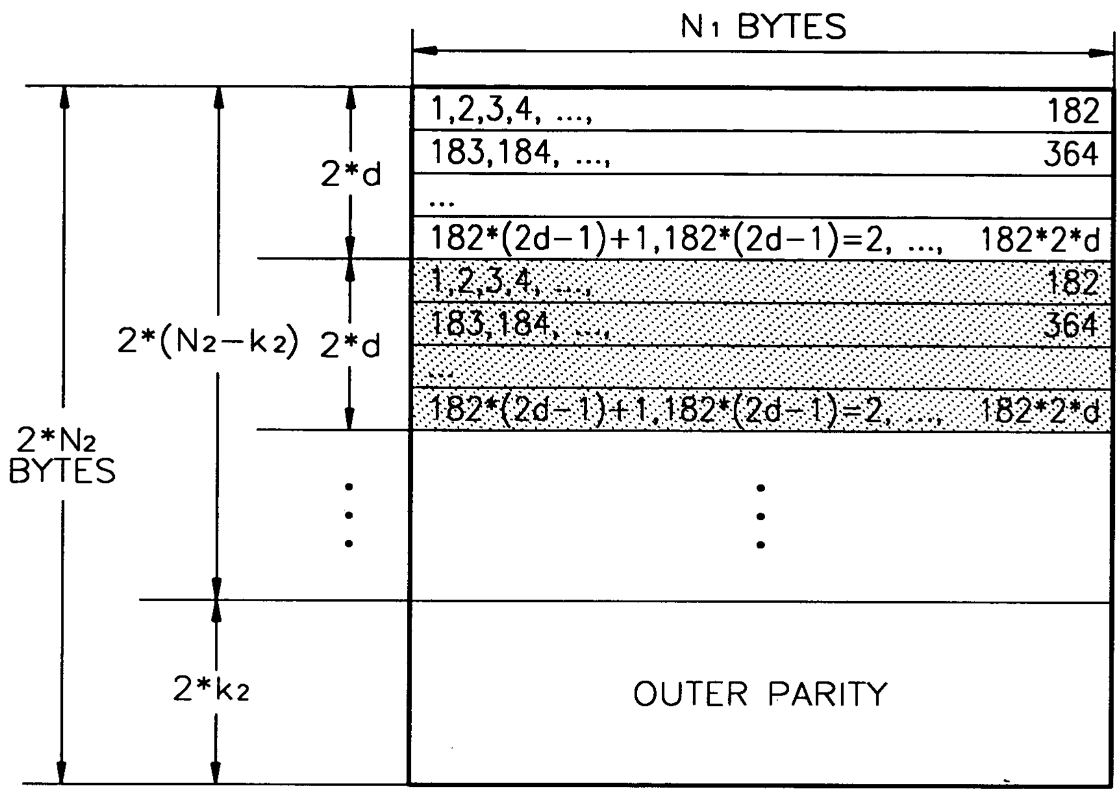

N1 BYTES
1,2,3,4, ...,
182
183,184, ...,
364
...
182*(2d-1)+1,182*(2d-1)=2, ...,
182*2*d
1,2,3,4, ...,
182
183,184, ...,
364
...
182*(2d-1)+1,182*(2d-1)=2, ...,
182*2*d
OUTER PARITY
2*d
2*d
2*(N2-k2)
2*N2 BYTES
2*k2

FIG. 4

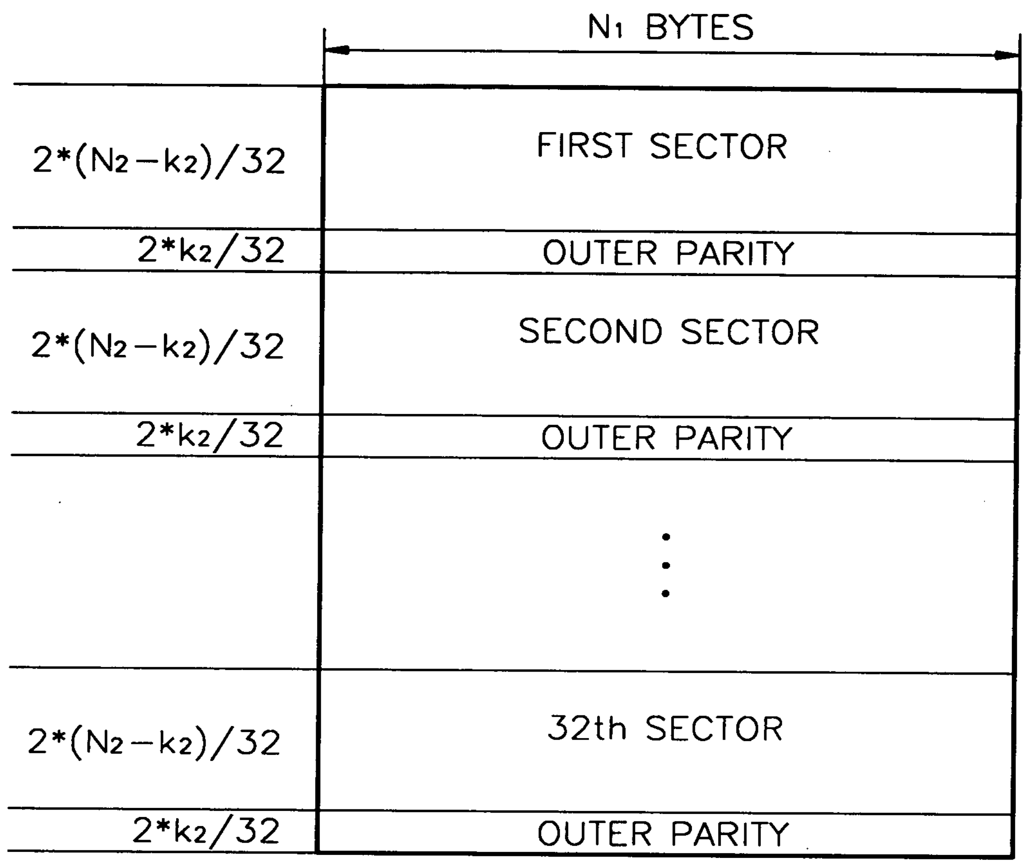

N1 BYTES
2*(N2-k2)/32
FIRST SECTOR
2*k2/32
OUTER PARITY
2*(N2-k2)/32
SECOND SECTOR
2*k2/32
OUTER PARITY
2*(N2-k2)/32
32th SECTOR
2*k2/32
OUTER PARITY

FIG. 5

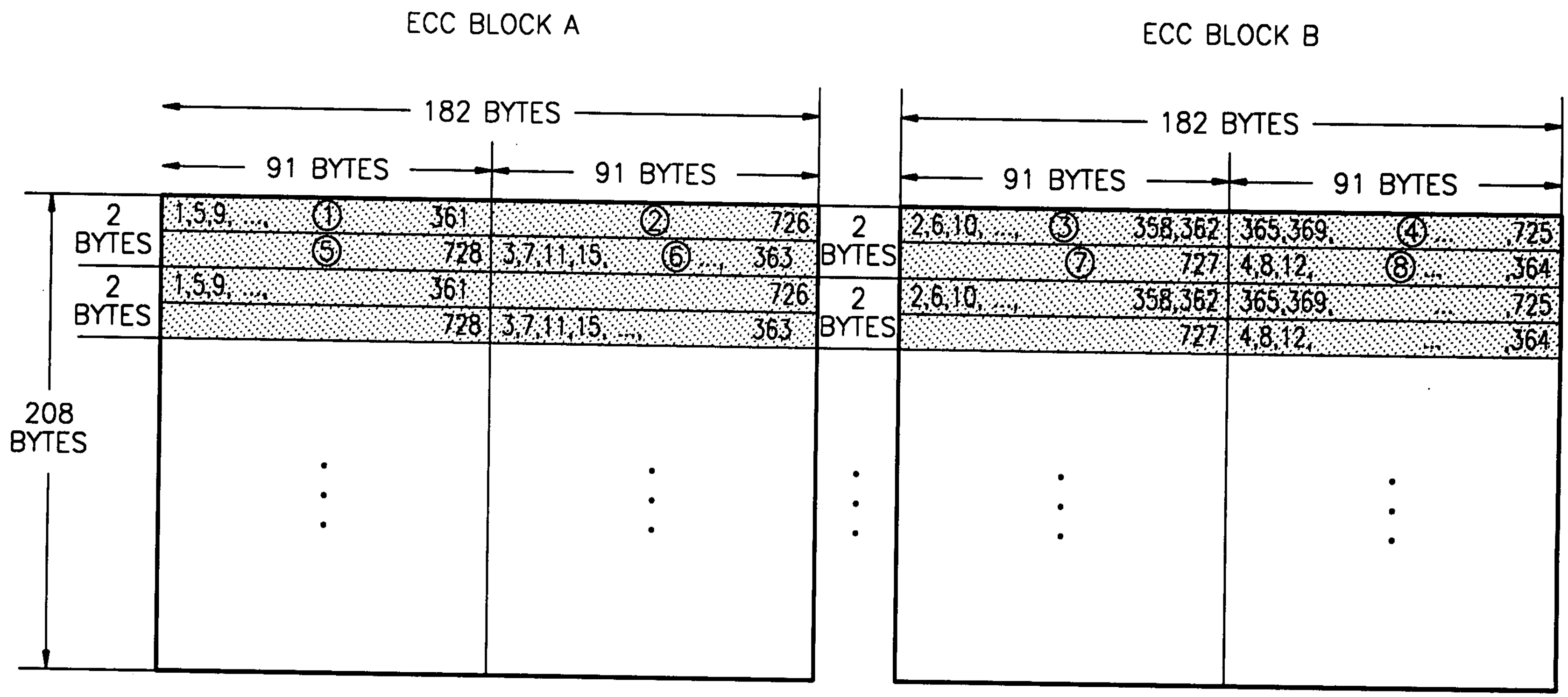
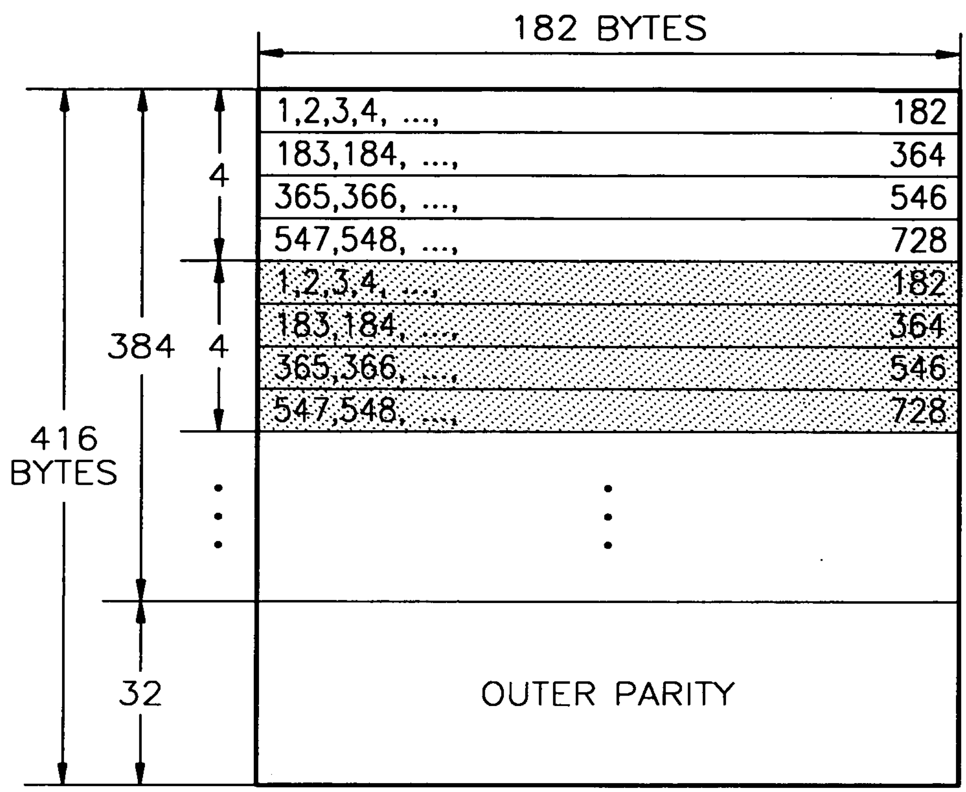

ECC BLOCK A
ECC BLOCK B
182 BYTES
91 BYTES
2 BYTES
208 BYTES
1,5,9, ...
361
726
728
3,7,11,15,
363
2,6,10, ...,
358,362
365,369,
725
727
4,8,12,
364
1
2
3
4
5
6
7
8

FIG. 6



182 BYTES
1,2,3,4, ...,
182
183,184, ...,
364
365,366, ...,
546
547,548, ...,
728
1,2,3,4, ...,
182
183,184, ...,
364
365,366, ...,
546
547,548, ...,
728
4
4
384
416 BYTES
32
OUTER PARITY

FIG. 7

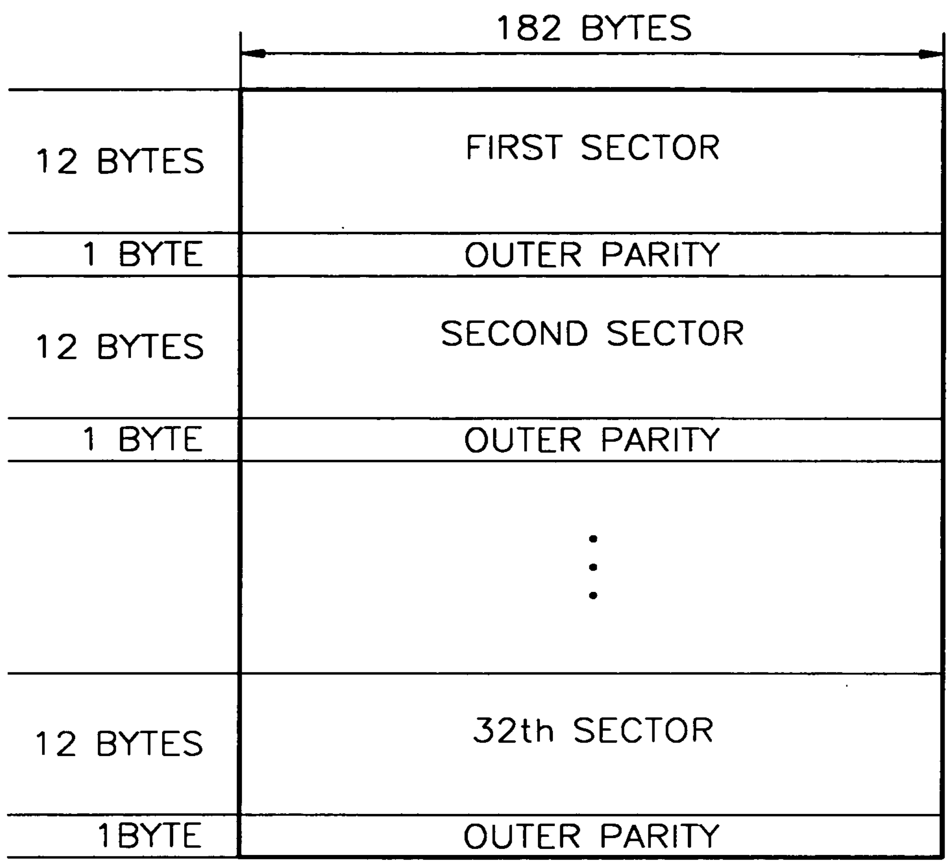
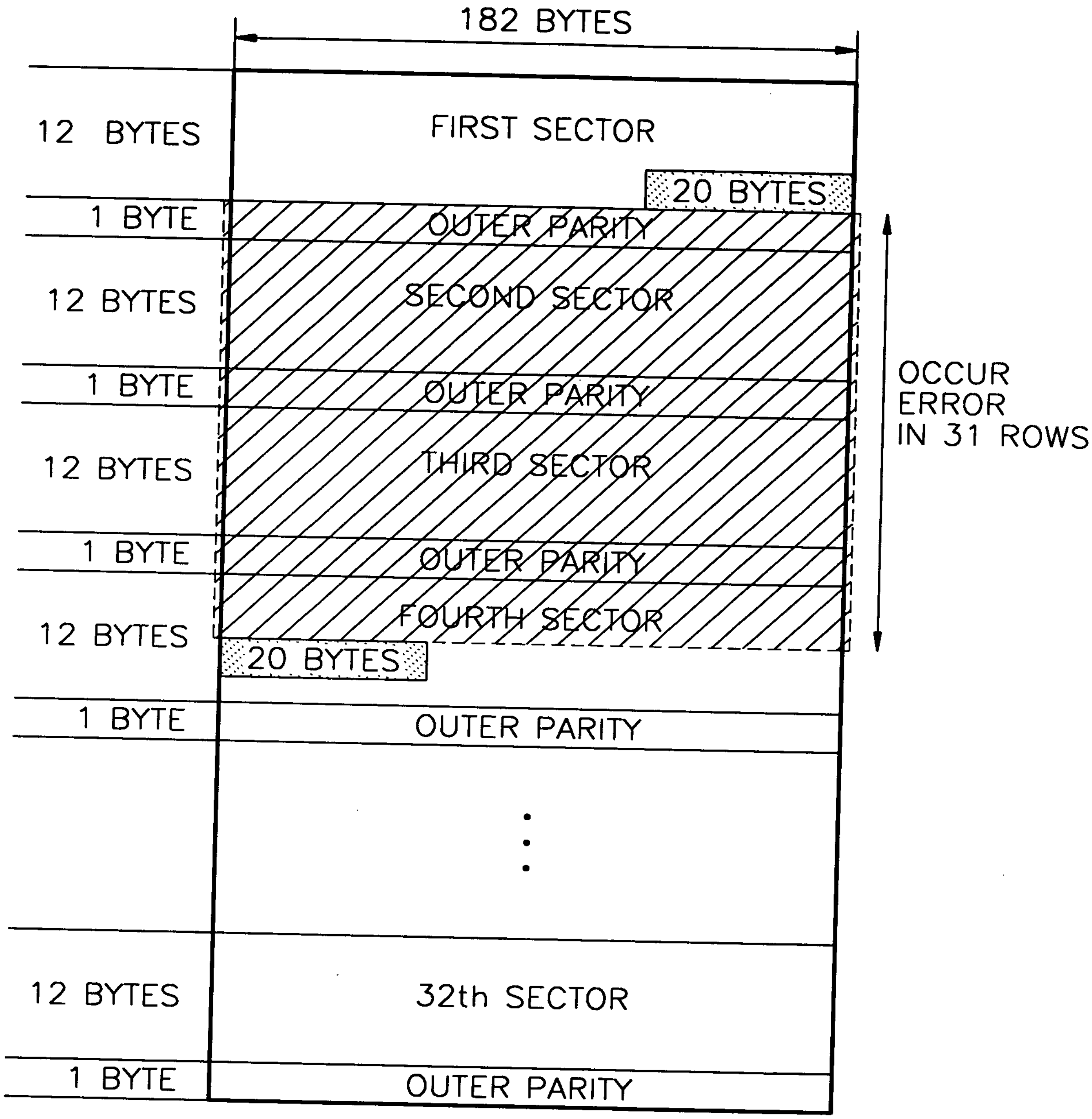

182 BYTES
12 BYTES
FIRST SECTOR
1 BYTE
OUTER PARITY
12 BYTES
SECOND SECTOR
1 BYTE
OUTER PARITY
12 BYTES
32th SECTOR
1BYTE
OUTER PARITY

FIG. 8



182 BYTES
12 BYTES
FIRST SECTOR
20 BYTES
1 BYTE
OUTER PARITY
12 BYTES
SECOND SECTOR
1 BYTE
OUTER PARITY
12 BYTES
THIRD SECTOR
1 BYTE
OUTER PARITY
12 BYTES
FOURTH SECTOR
20 BYTES
1 BYTE
OUTER PARITY
12 BYTES
32th SECTOR
1 BYTE
OUTER PARITY
OCCUR
ERROR
IN 31 ROWS

FIG. 9A

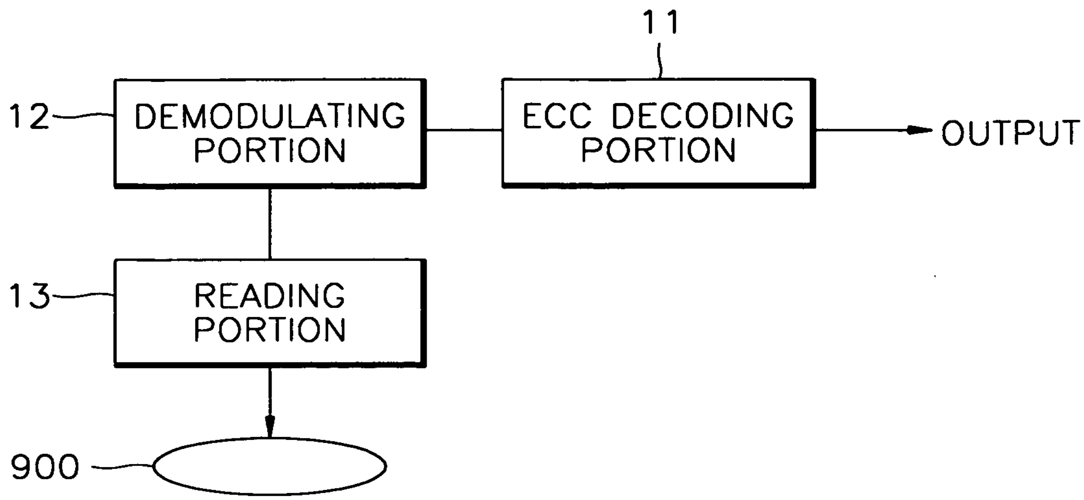
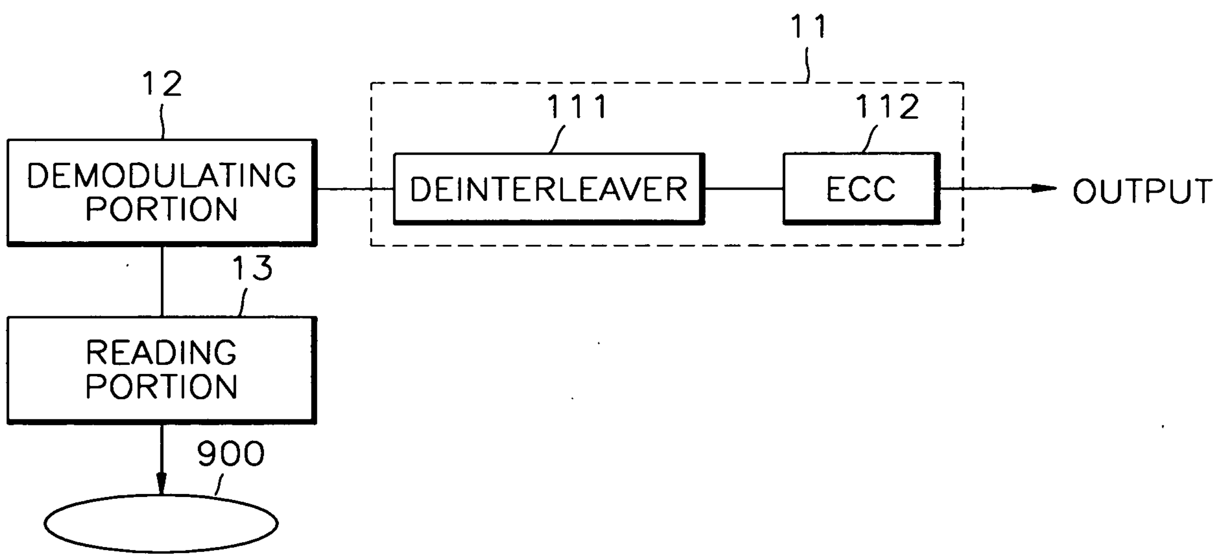

11
12
DEMODULATING PORTION
ECC DECODING PORTION
OUTPUT
13
READING PORTION
900

FIG. 9B


11
12
111
112
DEMODULATING PORTION
DEINTERLEAVER
ECC
OUTPUT
13
READING PORTION
900